

Confirmed presence of the exotic guppy *Poecilia reticulata* Peters, 1859 from southern Iran with length-weight data

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Abstract. Guppy - *Poecilia reticulata*, an exotic species, is recorded from a natural freshwater in Hormuz basin, which shows the range extension of the fish to southern Iran. This fish was probably introduced as an aquarium fish, but seems it is established in Sabz-poushan Spring. This study also describes the length-weight relationship (LWR) for the 13 caught specimens of the fish. The length-weight parameter b for this species was 3.01 with a high regression coefficients ($r^2 > 0.95$).

Key Words: aquarium, exotic fish, Hormuz basin, Poeciliidae, population structure.

Introduction. A wide range of articles on native and exotic freshwater fishes of Iran are recently published in terms of taxonomy, biology and biogeography (Rashidi et al 2012; Azimi et al 2015; Eagderi et al 2019; Vatandoust et al 2019; Mousavi-Sabet et al 2021; Esmaeili et al 2022). Introductions of fish species into Iranian water bodies dates back a long time but were most prominent in the 1920s when the mosquitofish, *Gambusia holbrooki* (Poeciliidae) was introduced as an anti-malarial agent (Jouladeh-Roudbar et al 2015; Radkhah et al 2016; Mousavi-Sabet 2018, 2019; Mousavi-Sabet et al 2023). Since then, about 29 confirmed species (about 9.9% of its ichthyofauna), belonging to eleven families have been recorded from the country in the latest published checklist (Eagderi et al 2022), which then Mousavi-Sabet et al (2023) added two more species to the list. Aquaculture, aquarium trade, sport fishing, control of malaria, research and accidental introductions have been the main reasons for these introductions (Mousavi-Sabet 2018, 2019; Mousavi-Sabet et al 2023).

The family Poeciliidae includes live-bearing fishes of small size (< 200 mm length) having diverse morphology and coloration, with distribution in the freshwater and brackish environments of the eastern United States, South America, and Africa, including Madagascar (Moyle 2002; Nelson 2006). A myriad of poeciliids have been widely and deliberately introduced worldwide for mosquito control (Fuller et al 1999) or the aquarium trade (Crossman & Cudmore 1999) due to their short generation time, colorfulness, hardiness, and readiness to breed in captivity (Moyle 2002). The most distributed exotic poeciliid in Iran (almost in whole country) is *Gambusia holbrooki* (Mousavi-Sabet & Eagderi 2014; Jouladeh-Roudbar et al 2015; Mousavi-Sabet 2018). However, later other poeciliids were introduced into the country due to ornamental fish trade (Mousavi-Sabet & Eagderi 2014, 2016; Mousavi-Sabet 2018), as these are popular fish species for hobbyist and interesting models for researchers in the country (Faghani-Langroudi et al 2014a; Moshayedi et al 2015a, b; Khiabani et al 2016).

A few research papers have dealt with biological characteristics of exotic species including length-weight relationship (LWR) in Iran, therefore the biology of these nonnatives is barely known in the country. Information on LWR of fishes are a useful tool for biologist in fisheries for their assessment and proper management due to providing the estimation of biomass from length observation (Mousavi-Sabet et al 2016a; Alavi-

Yeganeh et al 2018; Heidari et al 2018). Fish LWRs are useful for converting length observations into weight estimates to provide some measure of biomass (Froese 1998, 2006; Mousavi-Sabet et al 2015, 2016b). This information is necessary for fisheries management in the area as well as for estimation of the biomass of the fish species (Froese 1998, 2006; Mousavi-Sabet et al 2016c; Faghani-Langroudi et al 2014b; Mousavi-Sabet et al 2016d). The general biology including LWR for exotic/invasive fish species in Iranian inland waters is barely known (Mousavi-Sabet et al 2013a, b; Heidari et al 2018). Therefore the specific objectives of this study were to report the range extension of the exotic species in Iran and determine LWR of the fish from the Sabz-poushan Spring, in Hormuz basin, south of Iran.

Material and Method. Sampling was carried out by hand net (mesh size: 2 mm) from Sabz-poushan Spring (28.258012°, 55.751949°), during fieldwork in the Hormuz basin, southern Iran, on 8 February 2022. The collected specimens were preserved in 10% formalin after anesthetizing with 1% clove solution and transferred to laboratory for further processing. Total (TL) and standard (SL) lengths (± 1.0 mm) and body weight (± 0.1 g) were recorded for each fish specimen. LWR was calculated using the formula $W = aL^b$, where W is the total weight (g), L is the total length (cm) and a and b are regression coefficients (Ricker 1973). For LWR with $r^2 < 0.95$ the regression was repeated after removing outliers (Froese 2006). Outliers observed in the log-log plots of all species were excluded from the regression. The parameters a and b were estimated by linear regression: $\log(W) = \log(a) + b \log(L)$ (Froese 1998, 2006).

Results and Discussion. A total of 13 individuals (8 females and 5 males) of *P. reticulata* were collected from Sabz-poushan Spring. The collected specimens were characterized by an anteriorly pointed and compressed body, a depressed head, large cycloid scales on the head and body, a large dorsal fin, and a small and terminal mouth with a lower projecting jaw. Sexual dimorphism is clear in adult specimens as males have a developed gonopodium, a specialized reproductive fin found only in male fish (Mousavi-Sabet 2018).

It seems that *P. reticulata* was introduced into Iran as an aquarium fish, but is now recorded from three natural habitats in three different basins, including Namak Lake, the southern Caspian Sea and Hormuz basins. *Poecilia reticulata* from the studied sampling site showed a restricted distribution and established breeding population, acting as invaders. This species may have negative impact on native fish populations through competition, habitat changes, and introduction of parasites and diseases (Mousavi-Sabet et al 2023).

The total of 13 individuals (15-31 mm SL, 0.1-0.5 g) were included in LWR analysis. Sample descriptive statistics and estimated parameters of LWR are given in Table 1. The value of parameter b was 3.01 with r^2 value 0.95.

Table 1

Descriptive statistics and parameters of LWR for *P. reticulata* determined from samples collected in Sabz-poushan Spring, Hormuz basin, southern Iran

<i>Species</i>	<i>n</i>	<i>Length (cm)</i>	<i>Weight (g)</i>	<i>a</i>	<i>b</i>	<i>r</i> ²
<i>P. reticulata</i>	13	1.5-3.1	0.1-0.5	0.011	3.01	0.95

n = sample size; *a* = intercept; *b* = slope; *r*² = coefficient of determination.

The parameter b of the studied species was 3.01. According to Bagenal & Tesch (1978), the range of b could be from 2 to 4 and $b = 3$ in fish with isometric growth. This study is the first report on LWR for *P. reticulata* from a natural aquatic habitat in Iran and can serve as a baseline for future studies.

There are some differences in the functional regression b value in available data on LWR for *P. reticulata* from different countries, including 2.47 (Peru), 2.98, 2.99, 3.00, 3.09 and 3.11 (from different basins in Brazil) (Froese & Pauly 2023). It is well known that the functional regression b value represents the body form of fish (Ricker 1973;

Kalayci et al 2007; Mousavi-Sabet et al 2014, 2017a, b), and is affected by a number of factors such as gonad maturity, sex, diet, stomach fullness, health, age, fishing time as well as the area and fishing vessels (Wootton 1998); however, these factors were not considered in the present study.

Conclusions. *Poecilia reticulata*, like the other introduced species, may cause harm to native fishes because of its ability to reproduce rapidly. As the introduction of exotic fishes may affect populations of native fishes through predation, competition, habitat changes, genetic changes, and introduction of parasites and diseases, special care should be taken to prevent such introductions. Eradication programs can be successful in the case of *P. reticulata*. Since, there is a possible chance of success because of they have yet very limited distribution. However, such programs have to be accompanied by a public awareness campaign to ensure that the aquarium trade and hobbyists do not release these pet fishes into natural habitats. Monitoring of this fish is highly recommended. The present study also presented basic information on LWR for the exotic *P. reticulata* in Iran, which would be useful for fish biologists to control exotic species in the region. The narrow sample size or the length range possibly affected the *b* value of the study. Thus, differences in LWR between this and other studies could be potentially attributed to the combination of one or more of the factors given above.

Acknowledgements. The author would like to thank Heiko Bleher and Saeid Asadi for helping with the fish collection in Hormuz basin and the University of Guilan for financial support.

Conflict of interest. The author declares that there is no conflict of interest.

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Received: 17 July 2023. Accepted: 02 September 2023. Published online: 22 September 2023.

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How to cite this article:

Mousavi-Sabet H., 2023 Confirmed presence of the exotic guppy *Poecilia reticulata* Peters, 1859 from southern Iran with length-weight data. *Poec Res* 13(1):9-13.